



(ATOMIC ENERGY)

ASSISTANT TO THE SECRETARY OF DEFENSE
WASHINGTON, DC 20301-3050

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ay as requested
(R)
19 SEP 1988

MEMORANDUM FOR DIRECTOR, SPACE AND SPECIAL WEAPONS DIRECTORATE
(DAMO-SW), DEPARTMENT OF ARMY

SUBJECT: Standards for Electromagnetic Pulse (EMP) Radiation
Exposure

We agree that the environmental aspects of EMP exposure are important issues that must be resolved to allow the resumption of normal EMP testing. However, as you are well aware, it is not a straightforward technical problem, but rather a highly faceted problem involving legal, medical, and public opinion issues. This was made clear during an August 12 meeting at the US Army Nuclear and Chemical Agency (USANCA), a September 9 meeting with the Services and the Deputy Assistant Secretary of Defense (Environment) (DASD(E)), and by our separate discussions with a number of organizations. The problem seems to be first to identify the problem--is it one of establishing a standard for EMP exposure on personnel?; is it one of completing the EIS/EAs for all the simulators?; or is it one of satisfying the judicial system or the Foundation on Economic Trends?

[REDACTED]

[REDACTED]

a. [REDACTED]


[REDACTED]

b. [REDACTED]

[REDACTED]

[REDACTED]

#418



In the meantime, our Chemical Matters staff has already gone through the EIS/EA process in their areas of research. If you believe that your EMP EIS/EA efforts could benefit from their experience, we would be pleased to arrange a meeting.

Scott B. Smith

Scott B. Smith

Major General, USA

Deputy for Military Applications

ATSL (HE)
(12) (6)

MEMO For: MG Smith

28 Oct 88

SUBJECT: EMP Exposure Standards

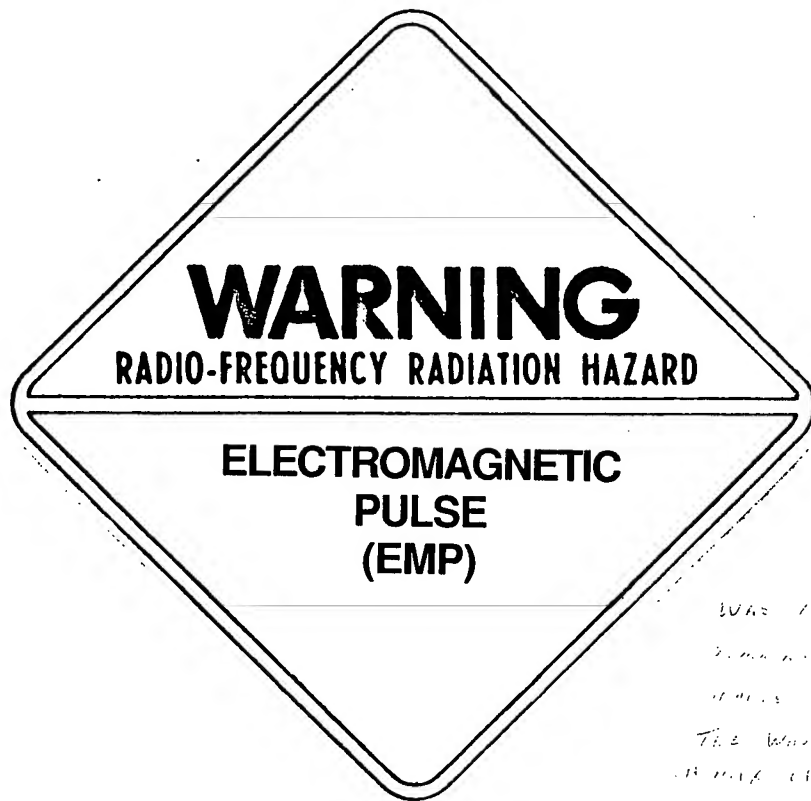
Gen Eggelston may make a comment about the USANCA human exposure standard effort. I talked with Andy Johnson this week after he got the package I gave you before you left. He seems to be single-minded about getting a long-term biological exposure standards program going at DNA/AFRRI. Andy also suggested that High power microwaves (HPM) should be covered in the work. He is concerned that there should be some central body to ensure a coherent program and avoid duplication in research among the services. That is why they keep beating on us about DNA.

I told him again that I see the coordinating function of bio-research as being the Tri-Service Electromagnetic Radiation Panel (TERP) by DoDI 6055.11. That is why I encouraged Walter Reed Research Institute to put together a straw-man for EMP exposure research for this TERP meeting. It is tri-service and its responsibility is to coordinate bio-effects research on the effects of radiofrequency radiation. Walter Reed has been working on HPM and that is the main agenda item (as I understand it) of the upcoming TERP. This seems to me to be the appropriate group to approve EMP research and begin to get the process rolling. It also seems to answer all of Andy's concerns.

[REDACTED]

Paul
RF RAPIDS HIC USAS

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1. $W_{12} = 1$, $W_{13} = 0.5$
 2. $W_{21} = 1$, $W_{23} = 0.5$
 3. $W_{31} = 0.5$, $W_{32} = 0.5$
 The above situation is
 a mix of 1 & 2 , 3 & 4 ,
 but 1 & 2 are 1 & 2 ,
 3 & 4 are 3 & 4 .
 The above situation is
 a mix of 1 & 2 , 3 & 4 ,
 but 1 & 2 are 1 & 2 ,
 3 & 4 are 3 & 4 .

ENVIRONMENTAL CONCERNS

OVER YEARS, HAS BEEN VARIETY OF PROTECTIVE LEGISLATION

- **WORKERS/LABOR**
- **ENVIRONMENT**

ONE IN PARTICULAR--NATIONAL ENVIRONMENTAL PROTECTION ACT (NEPA)

- **ESTABLISHED PROCESS OF EVALUATION**
- **EVALUTE EFFECTS OF PROJECT ON ENVIRONMENT**
 - **ENVIRONMENTAL ASSESSMENT (EA)**
 - **ENVIRONMENTAL IMPACT STATEMENT**
 - **FINDING OF NO SIGNIFICANT IMPACT (FONSI)**

**ATTEMPTS TO ENSURE THAT RISKS ARE IDENTIFIED AND WEIGHED
AGAINST BENEFITS**

PROVIDES METHOD FOR INFORMED DECISION

EMP ENVIRONMENT ISSUES

HAVE OCCUPATIONAL EXPOSURE LIMITS FOR EM RADIATION

- WORKERS ARE THERE WITH KNOWLEDGE OF RISKS
- HAVE DODI 6055.1 PROVIDING EXPOSURE LIMITS
- NO INDUSTRY-WIDE STANDARDS FOR EMP EXPOSURE

DO NOT HAVE ENVIRONMENTAL EXPOSURE LIMITS FOR GENERAL PUBLIC

- HOW MUCH EXPOSURE IS REASONABLE??

THRESHOLD LIMIT VALUES and BIOLOGICAL EXPOSURE INDICES for 1989-1990



American
Conference
of Governmental
Industrial Hygienists
Cincinnati, Ohio

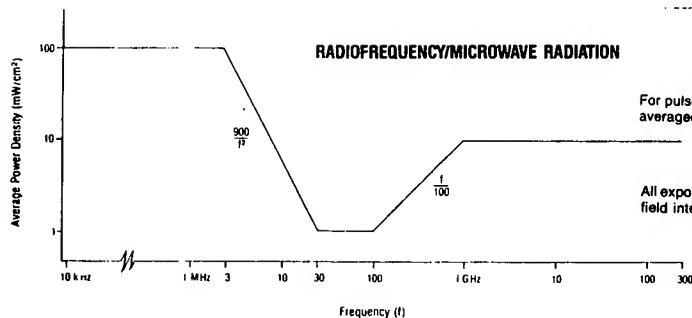
PHYSICAL AGENTS UNDER STUDY

The Physical Agents TLV Committee of ACGIH has examined the current literature and has not found sufficient information to propose a TLV. However, these agents will remain under study during the coming year to examine new evidence indicating the need and feasibility for establishing a proposed TLV. Comments and suggestions, accompanied by substantive documentation are solicited and should be forwarded to the Executive Secretary, ACGIH. Documentation summarizing the current status of the biological effects literature is available on those agents preceded by an asterisk (*).

1. *Low Frequency Magnetic Fields.*
2. *Laser Radiation.* Specifically laser exposures of less than one (1) nanosecond.
3. *Vibration.* Whole-body.
4. *Pressure Variations.*
5. *Electromagnetic Pulses.*
6. *Radiofrequency Radiation (RFR).* Peak power limits.
7. *Static Electric Fields.*

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For pulsed and continuous wave fields, the power density is averaged over the six-minute period.

All exposures should be limited to a maximum (peak) electric field intensity of 100 kV/m.

Figure 10—Threshold Limit Values (TLV) for Radiofrequency/Microwave Radiation in the workplace (whole body SAR less than 0.4 W/kg).

POSITION

GOVERNMENT POSITION:

EMP IS NOT A PROBLEM FOR PEOPLE

How can we help people

to find work

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Journal compilation © 2006 Blackwell Publishing Ltd

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CREATES SITUATION

WE TEST FOR EMP BECAUSE WE BELIEVE IT CAN DAMAGE ELECTRONICS
- **CANNOT PREDICT SURVIVABILITY OF UNHARDENED ELECTRONICS**

SMALL COMMUNITY OF PEOPLE EXPOSED OVER YEARS

- **POOR STATISTICS**
- **LESS THAN A GENERATION**
- **ACTIVELY TESTING FOR ONLY ~ 20 YEARS**
 - **MANY PROBLEMS SHOW UP AFTER LONG TIME**

CIVILIZATION CREEP HAS COME TO SIMULATORS

NOW COMES "PUBLIC" CONCERNS

FOUNDATION ON ECONOMIC TRENDS:

- **GOVERNMENT IS CONCERNED ABOUT IMPACT OF EMP ON MILITARY SYSTEMS**
- **ARE YOU CONCERNED ABOUT ITS IMPACT ON THE ENVIRONMENT AND NEARBY COMMUNITIES??**
- **YOU HAVE NOT FOLLOWED THE NEPA PROCEDURES!**

STATE OF MARYLAND CONCERNED ABOUT IMPACT TO CHESAPEAKE BAY

MEDIA HAS "FIELD DAY"

Potomac News

Manassas • Prince William County • Stafford

FRIDAY AFTERNOON

January 6, 1989

12 DIFFERENT NEWS Murders, November 14, 1988

Group Files Suit in Attempt to Stop Electromagnetic Pulse Simulator Effort

BY CALVIN BARKER
Defense News Editor
WASHINGTON
Navy's EMP simulator effort to test future military equipment is being challenged by a group of concerned citizens in a lawsuit filed in federal court.

WASHINGTON - The U.S. military's effort to test future military equipment is being challenged by a group of concerned citizens in a lawsuit filed in federal court.

Manassas • Prince William County • Stafford

Journal

FARFAX

Central location for pulse tests urged by EPA officials

BY GARY CRAG
Environmental News Editor
Defense officials should study a central location for testing electromagnetic pulse (EMP) effects on military equipment, according to EPA officials.

The EPA's Office of Research and Development is studying the effects of EMP on military equipment. The study is part of a larger effort to assess the potential for EMP to damage military equipment.

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Effects of Army pulse test disputed

Jointly Woodbridge antenna harmless, lab says

BY GARY CRAG
Environmental News Editor
A study of the effects of electromagnetic pulse (EMP) on military equipment is being challenged by a group of concerned citizens in a lawsuit filed in federal court.

The study is part of a larger effort to assess the potential for EMP to damage military equipment. The study is part of a larger effort to assess the potential for EMP to damage military equipment.

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A-bomb pulse site stirs concern here

BY GARY CRAG
Environmental News Editor
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Military radiation tests at heart of Boeing case

BY GARY CRAG
Environmental News Editor
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Army should halt EMP tests, official urges

BY GREG SWOPE
Environmental News Editor
A representative of the group which successfully halted electromagnetic pulse (EMP) tests

The group which successfully halted electromagnetic pulse (EMP) tests. The group which successfully halted electromagnetic pulse (EMP) tests. The group which successfully halted electromagnetic pulse (EMP) tests.

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Residents debate Army EMP effect

BY GARY CRAG
Environmental News Editor
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Army pushed to chart effect of EMP tests

BY GARY CRAG
Environmental News Editor
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Army urged to find remote pulse test site

BY GARY CRAG
Environmental News Editor
Army urged to find remote pulse test site

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RESULT

LAWSUIT FILED MARCH 10, 1987

- **GOVERNMENT MUST STOP "NATIONAL EMP PROGRAM"**

DEFENSE SHOWS MIXED BAG OF COMPLIANCE OVER NEXT YEAR

- **NAVY WORKING ON EA/EIS'S FOR EMPRESS I/II**
- **AIR FORCE HAD EA'S FOR SIMULATORS**
- **DNA PRODUCED EA FOR ARES**
- **ARMY BEGAN WORK ON EA'S**
 - **WOODBRIIDGE DID NOT FINISH**

OUT OF COURT SETTLEMENT

- **ARMY-WOODBRIDGE COULD OPERATE - 1 KV/M AT BOUNDARY**
- **EA/EIS'S TO BE PRODUCED**
- **RESERVES RIGHT TO CHALLENGE EA/EIS'S**

How, in fact, will the Secretary, Mr. Hargis

SIMULATOR STATUS

EA/EIS

REMARKS

ARMY

AESOP
VEMPS I
VEMPS II
REPS

ALL WORK
TERMINATED

POLICY DECISION TO CEASE EMP
TESTING AT WOODBRIDGE
NOTICE OF INTENT TO DO EIS FOR ALL
SIMULATORS AT REMOTE SITE--TBD

NAVY

EMPRESS I
EMPRESS II

EA/JUNE 88
EIS-REC OF DEC
JUNE 88

NO TESTING IN CHESAPEAKE SINCE 87
JUNE-AUGUST OPNS OFF VA CAPES
STUDY GULF OPNS NOV-APR
OCT 88--CHALLENGE TO ADEQUACY
NAVY CONFIDENT

AIR FORCE

ALECS
HPD
VPD II
TRESTLE

NO RECORD
EA/MID 72
EA/13 JAN 76
EA/ 12 OCT 76

NEW EA'S FOR ALL IN FINAL REVIEW

TINKLE

EA/13 JAN 76

DNA

ARES

EA/25 APR 88

IN GENERAL—POLLUTION PROBLEM

3 WAYS TO SOLVE POLLUTION PROBLEM

1. SHOW IT IS NOT A PROBLEM

- EVERYTHING IS BAD AT SOME LEVEL

2. SHOW THERE IS A SAFE LEVEL

- IMPLIES A THRESHOLD OF EFFECT
 - ASSUMES TOLERANCE TO EFFECT AT LOW LEVEL
- HAVE NOT IDENTIFIED CAUSE & EFFECT
 - BIOTECHNOLOGY IS CONTINUALLY IMPROVING DETECTION
- WE CONTEND THAT ELECTRONICS ARE GETTING MORE SENSITIVE
 - WE THEREFORE MUST BE AT A SAFER LEVEL

3. PREVENT POLLUTION FROM ENTERING ENVIRONMENT OF CONCERN

- BUILD/USE SIMULATORS AWAY FROM CIVILIZATION
- BUILD NON-RADIATING SIMULATORS
- CONTAIN RADIATION IN SIMULATOR (SHIELDS/ABSORBERS, ETC.)

FINALLY

STILL NAGGING QUESTION ABOUT OURSELVES

- DON'T KNOW OF PROBLEMS
- HOW DO YOU PROVE NOTHINGNESS??

PRUDENT TO KEEP ALERT AND REVIEW KNOWLEDGE

- ATSD(AE) ENCOURAGED WRAIR PROPOSAL TO TERP

TRI-SERVICE ELECTROMAGNETIC RADIATION PANEL

- COORDINATES BIO-EFFECTS RESEARCH

*the Chapter
A 1961 document by the Air Force, Navy, and Army
The document was a review of the status of research on
the effects of electromagnetic radiation on man
Heard the Air Force, Navy, and Army were working
on a joint project to develop a common database
on the effects of electromagnetic radiation on man
and to develop a common approach to the study of the effects of electromagnetic radiation on man*



Department of Defense INSTRUCTION

Handwritten:
12 AUG 82
11:00 AM
NTIS

August 20, 1986
NUMBER 6055.11

ASD (FM&P)

SUBJECT: Protection of DoD Personnel from Exposure to Radiofrequency Radiation

- References:
- (a) DoD Directive 1000.3, "Safety and Occupational Health Policy for the Department of Defense," March 29, 1979
 - (b) DoD Instruction 6055.8, "Occupational Radiation Protection Program," January 3, 1983
 - (c) DoD Directive 5124.2, "Assistant Secretary of Defense (Force Management and Personnel)," July 5, 1985
 - (d) American National Standards Institute (ANSI) C95.1-1982, "American National Standard Safety Levels with Respect to Human Exposure to Radiofrequency Electromagnetic Fields, 300 KHz to 100 GHz," July 30, 1982
 - (e) through (j), see enclosure 1

A. PURPOSE

This Instruction supplements references (a) and (b) to establish a uniform personnel protection policy for exposure to radiofrequency radiation resulting from Department of Defense operations.

B. APPLICABILITY AND SCOPE

This Instruction applies:

1. To Office of the Secretary of Defense (OSD) and its field activities, the Military Departments (including the Reserve components), the organization of the Joint Chiefs of Staff (OJCS), the Unified and Specified Commands, and the Defense Agencies (hereafter referred to collectively as "DoD Components").
2. To all DoD civilian (appropriated and nonappropriated funds) and military personnel who may be exposed to radiofrequency radiation (RFR) in excess of the permissible exposure limits stated below, except personnel who, as patients, undergo diagnostic or therapeutic procedures in medical or dental treatment facilities.

C. DEFINITIONS

Terms used in this Instruction are defined in enclosure 2.

D. POLICY

It is DoD policy to:

1. Identify, practically eliminate, attenuate, or control by engineering design, protective equipment, administrative action, or a combination thereof, hazardous RFR and other dangers associated with DoD electronic equipment.

and (e)). Sufficient evidence exists to indicate that a fetus is at no greater risk than the mother during pregnancy. A fetus will not receive any greater exposure than the mother and cannot be shown to be more radiosensitive.

b. For the purpose of determining compliance with the 0.4 W/kg whole body absorbed power limit the derived equivalent PEL's in Tables 1A and 1B and Figure 1 (enclosure 3) are provided. These derived equivalent PEL's, which were determined experimentally and theoretically, will ensure that individuals exposed in a uniform RFR field at those levels will receive a whole body SAR of less than 0.4 W/kg. Derived equivalent PEL's are provided for exposures that may occur in restricted areas (Table 1A, enclosure 3) and in unrestricted areas (Table 1B, enclosure 3). These two distinct derived equivalent PEL categories will ensure that personnel do not receive exposures greater than 0.4 W/kg while operating in restricted areas.

c. The derived equivalent power density PEL's in Tables 1A and 1B, (enclosure 3) and Figure 1, (enclosure 3) are for far-field (plane wave) conditions and apply only where a strict far-field relationship between both electric AND magnetic fields exists. In radiating near-field and reactive near field conditions or at low frequencies (10 KHz to 3 MHz) the electric and magnetic field strength limits in Tables 1A and 1B must be used to determine compliance with the PEL's.

d. RFR equipment which radiates at frequencies below 1,000 MHz and delivers less than 7 watts of RF power to the radiating device is considered nonhazardous.

e. All exposures should be limited to a maximum (peak) electric field intensity of 100,000 volts/meter (V/m) in a single pulse.

f. For mixed or broadband fields at a number of frequencies for which there are different values of PEL's, the fraction of the PEL incurred within each frequency interval should be determined and the sum of all such fractions should not exceed unity. When multiple transmitters are in use in the same frequency interval, the total field from all transmitters emitting simultaneously shall not exceed the PEL.

g. The derived equivalent PELs in Tables 1A and 1B and Figure 1, (enclosure 3) may be increased under special circumstances provided that:

(1) The specific absorption rate (SAR) does not exceed 0.4 W/kg when averaged over the whole body over any 6-minute period.

(2) The spatial peak SAR (hot spot) does not exceed 8.0 W/kg averaged over any 1-gram of tissue.

(3) Personnel are adequately protected from electric shock and radiofrequency (RF) burns through the use of electrical safety matting, electrical safety shoes, or other isolation techniques.

(4) The maximum (peak) electric field intensity does not exceed 100,000 v/m.

(5) The provisions of paragraph F.2.h., below, are met.

6. Investigation of Incidents.

a. Each DoD Component shall develop procedures to ensure that all incidents involving alleged or actual overexposure to RFR are investigated and documented. Investigation of incidents involving alleged or actual exposures of 5 times the PEL or greater must include, as a minimum, measurement of exposure levels, appropriate medical examination (reference (f)), a detailed description of the circumstances surrounding the incident, recommendations for medical follow-up, if necessary, and recommendations to prevent recurrence of the incident.

b. Each DoD Component shall maintain a file on all investigations of incidents in which the alleged exposure exceeded 5 times the PEL.

7. Radiofrequency Radiation Hazard Training. All DoD occupational workers defined in enclosure 2 shall receive RFR hazard training. Training shall be conducted during basic technical training or before assignment to work areas involving RFR exposure. Personnel shall take annual refresher training to reemphasize and reinforce training objectives. All such training shall be appropriately documented.

8. Measurement and Evaluation of RFR Hazards. DoD Components shall evaluate the hazards from RFR sources using the procedures recommended in ANSI C95.3-1979, (reference (g)), ANSI C95.5-1981, (reference (h)) and subsequent ANSI revisions to same. Each DoD Component shall maintain a file consisting of surveys, reports and theoretical calculations for each standard system.

9. RFR Bioeffects Research. DoD Components' research programs defining the biomedical effects of RFR unique to DoD operations shall be coordinated through the Tri-Service Electromagnetic Radiation Panel (TERP).

10. Research and Development. DoD Components shall establish specifications and standards for research, development, and production of RFR sources to identify potential RFR hazards and incorporate adequate protection from those hazards early in the development process. MIL-STD 882B, (reference (i)) and the requirements of this Instruction shall be used to ensure that safety, consistent with mission requirements for RFR emitters, is designed into the system at the earliest possible stage of the system life cycle. The orderly transition of technical and safety data developed during Research, Development, Testing and Evaluation (RDT&E) to operational system managers shall ensure proper controls and directives are developed.

11. Operational Systems. DoD Components shall include RFR safety and occupational health requirements in all procurement activities for operation, maintenance and repair of RFR sources and equipment. All appropriate technical orders, handbooks, manuals and other publications related to operational RFR systems shall contain necessary safety and occupational health requirements. MIL-STD 454J (reference (j)) shall be used for proper placement of all RFR emitters.

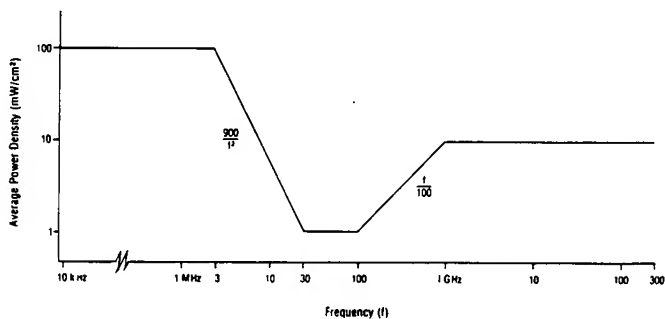
REFERENCES continued

- (e) American Conference of Governmental Industrial Hygienists (ACGIH), "Threshold Limit Values for Chemical Substances and Physical Agents in the Work Environment and Biological Exposure Indices With Intended Changes for 1984-1985," 1984
- (f) DoD 6055.5-M, "Occupational Health Surveillance Manual," July 1982, authorized by DoD Instruction 6055.5, April 30, 1980
- (g) American National Standards Institute (ANSI) C95.3-1979, "American National Standard Techniques and Instrumentation for the Measurement of Potentially Hazardous Electromagnetic Radiation at Microwave Frequencies,"
- (h) American National Standards Institute (ANSI), C95.5-1981, "American National Standard Recommended Practice for the Measurement of Hazardous Electromagnetic Fields - RF and Microwave,"
- (i) MIL-STD 882B, "System Safety Program Requirements," March 30, 1984
- (j) MIL-STD 454J, "Standard General Requirements for Electronic Equipment," April 30, 1984

DEFINITIONS

1. Average Power. The time average rate of energy transfer. Usually expressed in watts or milliwatts.
2. Electric Field. A fundamental component of radiofrequency (RF) electromagnetic waves, which exists when there is a voltage potential difference between two points in space. (See No. 4, below, Field Strength.)
3. Far Field (Fraunhofer region, plane wave region). The region far from an antenna, compared to the size of the antenna and the wavelength of the radiation, where the power decreases with the square of the distance from the source. In this region the radiation has the properties of a plane wave. (See No. 10, below, Plane Wave.)
4. Field Strength. The magnitude of the electric field (in volts/meter) or magnetic field (in amps/meter).
5. Magnetic Field. A fundamental component of electromagnetic waves produced by a moving electric charge. (See No. 4, above, Field Strength.)
6. Near Field. The electromagnetic field that exists relatively near the radiofrequency radiation source. In this area the electric and magnetic fields do not exhibit a plane wave relationship, and the power does not decrease with the square of the distance from the source. The near field region is further subdivided into the reactive near field region, which is closest to the antenna and contains most or nearly all of the stored energy associated with the field of the antenna, and the radiating near field region, where the radiation field predominates over the reactive field but lacks substantial plane wave character and is complicated in structure.
7. Occupational Worker. DoD military or civilian personnel who routinely work in those areas where the potential exists for exposures above the permissible exposure limit (PEL). Examples of occupational workers are avionics maintenance personnel, communications maintenance personnel, and personnel who must perform duties which involve potential exposure to RFR above the PEL in restricted areas (as defined below), such as, flight lines, flight decks, antenna farms, etc.
8. Overexposure. Any human exposure to RFR which exceeds the established PEL.
9. Permissible Exposure Limit (PEL). The maximum level expressed in specific absorption rate (SAR) or derived equivalent power density, electric field strength, or magnetic field strength to which an individual may be exposed which, under the conditions of exposure, will not cause detectable bodily injury according to present medical knowledge.
10. Plane Wave. An electromagnetic wave characterized by mutually orthogonal electric and magnetic fields, which are related by the impedance of free space (377 ohms).
11. Power Density. The amount of power per unit area in an electromagnetic field, usually expressed in milliwatts per square centimeter or watts per square meter.

Figure 1. DERIVED EQUIVALENT PERMISSIBLE EXPOSURE LIMITS



DEPARTMENT OF DEFENSE

DIRECTIVES SYSTEM TRANSMITTAL

NUMBER
6055.11, Ch 1

DATE
June 12, 1987

DISTRIBUTION
6000 series

ATTACHMENTS

Page 4-1

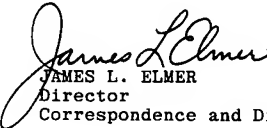
INSTRUCTIONS FOR RECIPIENTS

The following page change to DoD Instruction 6055.11, "Protection of DoD Personnel from Exposure to Radiofrequency Radiation," August 20, 1986, is authorized:

PAGE CHANGE

Remove: Page 4-1

Insert: Attached replacement page 4-1


JAMES L. ELMER
Director
Correspondence and Directives

WHEN PRESCRIBED ACTION HAS BEEN TAKEN, THIS TRANSMITTAL SHOULD BE FILED WITH THE BASIC DOCUMENT

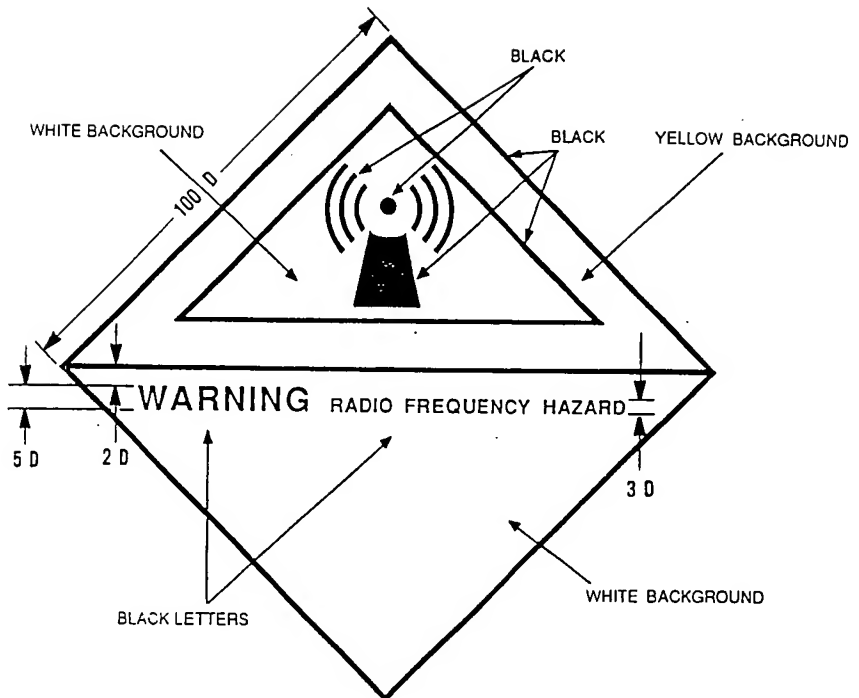


Figure 2

RADIOFREQUENCY RADIATION HAZARD

WARNING SYMBOL



Figure 2. RADIOFREQUENCY RADIATION HAZARD WARNING SYMBOL (ANSI C95.1-1982)